21. a) Independence Assumption and the Normal Model Assumption need to be met. To satisfy the Independence Assumption I will use the 10% Condition:

The 1200 New Yorkers is less than 10% of the population of those who live in NY.

To satisfy the Normal Model (Distribution) Assumption, I will use the Success/Failure Condition

$np \geq 10$ and $nq \geq 10$

$1200(.22) \geq 10$ and $1200(.78) \geq 10$

$264 \geq 10$ and $936 \geq 10$

Since both values are greater than or equal to 10, we can assume the Normal Model Assumption.

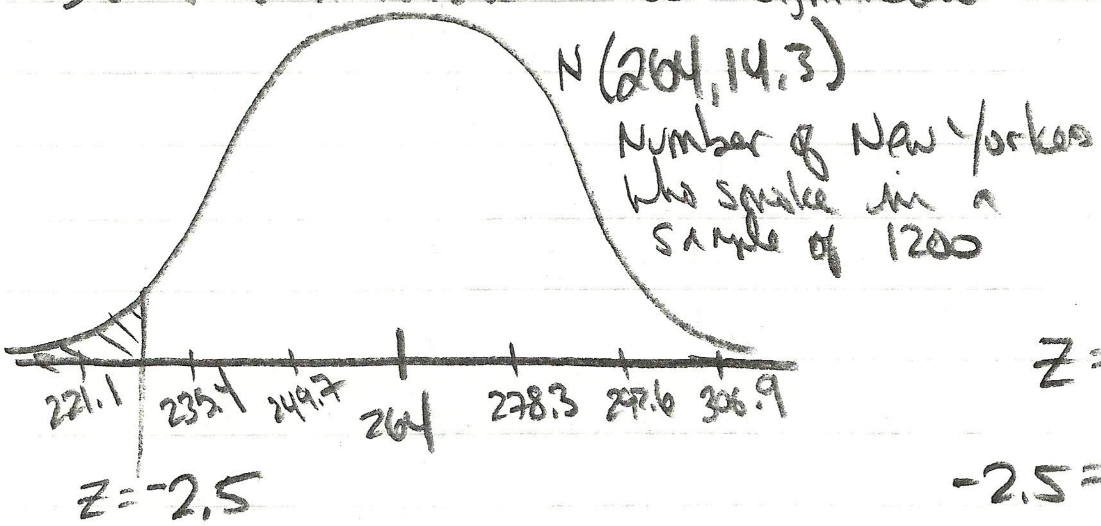
Since we verified both Conditions, we can model the Binomial using a Normal Model.

b) I will use a Normal Model to model the number of New Yorkes in sample who smoke

$\mu = np = 1200(.22) = 264$

$\sigma = \sqrt{npq} = \sqrt{1200(.22)(.78)} = 14.3$

I believe that if the number of people falls below 2.5 standard deviations below the mean, then that will indicate a "significant" decrease.



$$z = \frac{y - \mu}{\sigma}$$

$$-2.5 = \frac{y - 264}{14.3}$$

$$y = 228.25$$

About 229 people would indicate to me a significant decrease in the population that smokes.

22

a. Total outcomes = 36
Alphonso wins 16 times = 0.4444
Bettina wins 20 times = 0.5556

Or $P(B) = P(A\,gets\,2 \cap B\,gets\,3) = \frac{5}{6} \times \frac{4}{6} = \frac{20}{36}$

	8	2	2	2	2	2
3	A	B	B	B	B	B
3	A	B	B	B	B	B
3	A	B	B	B	B	B
3	A	B	B	B	B	B
1	A	A	A	A	A	A
1	A	A	A	A	A	A

b. If fair, $E(A) = \$10\left(\frac{16}{36}\right) + x\left(\frac{20}{36}\right) = 0$ or $x = -8$

So if Alphonso wins, he should pay Bettina $8 to make it a fair game.

$ Alphonso wins	$10	X
$P(A)$	$\frac{16}{36}$	$\frac{20}{36}$

c. Create a probability model for the amount Alphonso wins.

X= amount Alphonso wins	$8	$2	-$3
$P(X)$	$\frac{6}{36}$	$\frac{10}{36}$	$\frac{20}{36}$

	8	2	2	2	2	2
3	A8	B3	B3	B3	B3	. B3
3	A8	B3	B3	B3	B3	B3
3	A8	B3	B3	B3	B3	B3
3	A8	B3	B3	B3	B3	B3
1	A8	A2	A2	A2	A2	A2
1	A8	A2	A2	A2	A2	A2

d. $E(X) = \$8\left(\frac{6}{36}\right) + \$2\left(\frac{10}{36}\right) + (-\$3)\left(\frac{20}{36}\right) = \$0.22$

Standard deviation =

$$\sqrt{(8-0.22)^2\left(\frac{6}{36}\right)+(2-0.22)^2\left(\frac{10}{36}\right)+(-3-0.22)^2\left(\frac{20}{36}\right)} = \sqrt{16.7284} = 4.09$$

e. Alphonso has the advantage, because his expected value is positive. He expects to win an average of $0.22 for each time they play the game.

23) a) $E(X) = .2(10) + .4(8) + .3(6) + .1(0)$
$= 7$

$var(X) = (10-7)^2(.2) + (8-7)^2(.4) + (6-7)^2(.3) + (0-7)^2(.1)$

$= 1.8 + .4 + .3 + 4.9 = 7.4$

$SD(X) = \sqrt{var(X)} = \sqrt{7.4} = 2.72$

b) $E(X) = E(10) + E(8) + E(6) + E(0)$

$\mu = np$

$$\left.\begin{aligned} \mu_{10} &= E(10) = 25(.2) = 5 \\ \mu_8 &= E(8) = 25(.4) = 10 \\ \mu_6 &= E(6) = 25(.3)\ 7.5 \\ \mu_0 &= E(0) = 25(.1) = 2.5 \end{aligned}\right\}$$ Expected number of shots made in each point value

$\sigma_{10} = \sqrt{25(.2)(.8)} = 2 \Rightarrow \sigma^2 = 4$

$\sigma_8 = \sqrt{25(.4)(.6)} = 2.45 \Rightarrow \sigma^2 = 6$

$\sigma_6 = \sqrt{25(.3)(.7)} = 2.29 \Rightarrow \sigma^2 = 5.25$

$\sigma_0 = \sqrt{25(.1)(.9)} = 1.5 \Rightarrow \sigma^2 = 2.25$

b) $E\left[10\binom{\text{Exp}}{\text{\# of Bulls}} + 8\binom{\text{Exp \# of}}{\text{8 ring}} + 6\binom{\text{Exp \# of}}{\text{6 rings}} + 0\binom{\text{Exp \# of}}{\text{misses}}\right]$

$= 10(5) + 8(10) + 6(7.5) + 0(2.5)$

$= 175$ pts

$var\left[10\binom{\text{Exp \# of}}{\text{Bulls}} + 8\binom{\text{Exp \# of}}{\text{8 rings}} + 6\binom{\text{Exp \# of}}{\text{6 rings}} + 0\binom{\text{Exp \# of}}{\text{misses}}\right]$

$= 10^2 var(\text{Bulls}) + 8^2 var(\text{8 ring}) + 6^2 var(\text{6 ring}) + 0^2(\text{misses})]$

$= 100(4) + 64(6) + 36(5.25) + 0(2.25)$

$= 400 + 384 + 189 + 0$

$= 973$

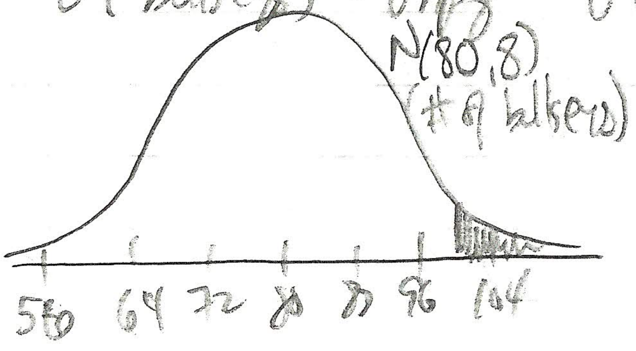
SD(For # of points in game) $= \sqrt{973} = 31.2$

c) I will use a Normal model (Check Success/Failure + 10% Condition)

$\mu(\text{bullseye}) = np = 400(.2) = 80$

$\sigma(\text{bullseye}) = \sqrt{npq} = \sqrt{400(.2)(.8)} = 8$

$> \frac{1}{4}$ of 400 $= 100$



$z = \frac{100-80}{8} = 2.5$

P-value $= p(Y > 100)$

$= p(z > 2.5)$

$= \boxed{.006}$